

**AMENDED CLAIMS**

[received by the International Bureau on 23 February 2004 (23.02.04);  
original claims 1 to 14 replaced by new claims 1 to 18; (5 pages)]

1. A controller comprising a device having a body  
portion and four and only four arms extending from the  
5 body portion which is adapted to support the controller,  
the arms being spaced from one another in three dimensions  
and the device having six or more degrees of constraint,  
tip portions of each of the arms engaging in connection  
means providing restricted relative motion, the connection  
10 means being attached to a gripping means which can receive  
and transmit an applied force and/or torque in a three  
dimensional sense, the controller including response  
detection means for monitoring responses in at least three  
of the four arms to provide an output signal  
15 representative of a three-dimensional force and/or a  
three-dimensional torque applied to the gripping means.
2. A controller as defined in claim 1, wherein the  
response detection means has means for directly monitoring  
20 response in three and only three of the four arms and the  
device further comprises means for calculating from data  
representing the monitored response in the three arms the  
values of a response in the fourth arm.
3. A controller as defined in claim 1, and wherein the  
25 controller is arranged to control a system with the output  
signal.
4. A controller as defined in claim 1 or claim 2,  
30 wherein the arms are arranged in a tetrahedron shaped  
envelope and are almost equally mutually spaced in a  
symmetrical sense with a small degree of non-symmetry to  
provide pre-loading at the connection means.
5. A controller as defined in any one of the preceding  
35 claims, wherein the arms are constrained such that the  
device has eight degrees of constraint.

6. A controller as defined in any one of the preceding claims, wherein the tip of each arm has a portion with a part-spherical profile and is slidable along a cylindrical bore associated with the connection means and rotatable relative to the axis of the bore.

7. A controller as defined in any one of the preceding claims, wherein each of the response detection means includes a plurality of optical sensors each of which has an emitter and a detector, the optical sensors being arranged substantially in the same plane and having respective optical axes transverse to the axis of the associated arm.

8. A controller as defined in claim 7, incorporating a total of 6 optical sensors disposed in pairs around three of the four arms.

9. A controller as defined in claim 1, and including a total of eight sensors provided in an array so that displacements in an X-Y set of responses for each of the four arms is achieved giving eight readings which can be resolved to give the required output signal.

10. A computer system comprising a controller including four and only four arms extending from a body portion which is adapted to support the device, the arms being spaced from one another in three dimensions and the device having six or more degrees of constraint, tip portions of each of the arms engaging in connection means providing restricted relative motion, the connection means being attached to a gripping means which can receive and transmit an applied force and/or torque in a three dimensional sense, the device including response detection means for monitoring responses in at least three of the four arms to provide an output signal representative of a

three-dimensional force and/or a three-dimensional torque to the gripping means, the output signal being arranged to control the computer system.

5 11. A computer system as defined in claim 10, wherein the response detection means has means for directly monitoring response in three and only three of the four arms and the device further comprises means for calculating from data representing the monitored response in the three arms the  
10 values of a response in the fourth arm.

12. A computer system as defined in claim 10 or claim 11, wherein the arms are arranged in a tetrahedron shaped envelope and are almost equally mutually spaced in a  
15 symmetrical sense with a small degree of non-symmetry to provide pre-loading at the connection means.

13. A computer system as defined in any one of claims 10-12, wherein the arms are constrained such that the device  
20 has eight degrees of constraint.

14. A computer system as defined in claim 13, wherein the tip of each arm has a portion with a part-spherical profile and is slidable along a cylindrical bore  
25 associated with the connection means and rotatable relative to the axis of the bore.

15. A computer system as defined in any one of claims 10-14, wherein each of the response detection means includes  
30 a plurality of optical sensors which are concentric and disposed on the same plane.

16. A computer system as defined in claim 15, incorporating a total of 6 optical sensors disposed in  
35 pairs around three of the four arms.

17. A controller comprising four and only four arms

extending from a body portion which is adapted to support the controller, the arms being spaced from one another in three dimensions and the device having six or more degrees of constraint, tip portions of each of the arms engaging in connection means providing restricted relative motion, the connection means being attached to a gripping means which can receive and transmit an applied force and/or torque in a three dimensional sense, the controller including response detection means for monitoring responses in three of the four arms to provide an output signal representative of a three-dimensional force and/or a three-dimensional torque applied to the gripping means and the device further comprising means for calculating from representing the monitored response in the three arms the values of a response in the fourth arm, and wherein the controller is arranged to control a system with the output signal, and wherein the arms are arranged in a tetrahedron shaped envelope and are almost equally mutually spaced in a symmetrical sense with a small degree of non-symmetry to provide pre-loading at the connection means, wherein the arms are constrained such that the device has eight degrees of constraint.

18. A controller comprising four and only four arms extending from a body portion which is adapted to support the controller, the arms being spaced from one another in three dimensions and the device having six or more degrees of constraint, tip portions of each of the arms engaging in connection means providing restricted relative motion, the connection means being attached to a gripping means which can receive and transmit an applied force and/or torque in a three dimensional sense, the controller including response detection means for monitoring responses in three of the four arms to provide an output signal representative of a three-dimensional force and/or a three-dimensional torque applied to the gripping means and the device further comprising means for calculating

from representing the monitored response in the three arms  
the values of a response in the fourth arm, and wherein  
the controller is arranged to control a system with the  
output signal, and wherein the arms are arranged in a  
5 tetrahedron shaped envelope and are almost equally  
mutually spaced in a symmetrical sense with a small degree  
of non-symmetry to provide pre-loading at the connection  
means, wherein the arms are constrained such that the  
device has eight degrees of constraint.

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